ArchéoSciences
33 (suppl.) (2009)
Mémoire du sol, espace des hommes

M. K. Saunders, S. M. Ovenden, S. Hamilton et C. Richards

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Référence électronique
M. K. Saunders, S. M. Ovenden, S. Hamilton et C. Richards, « Moai, quarries and roads. Experiences and results of geophysical survey on Rapa Nui (Easter Island) », *ArchéoSciences* [En ligne], 33 (suppl.) | 2009, mis en ligne le 30 octobre 2011, consulté le 03 janvier 2013. URL : http://archeosciences.revues.org/1479

Éditeur : Presses universitaires de Rennes
http://archeosciences.revues.org
http://www.revues.org

Document accessible en ligne sur : http://archeosciences.revues.org/1479
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Moai, quarries and roads. Experiences and results of geophysical survey on Rapa Nui (Easter Island)

M. K. Saunders *, S. M. Ovenden *, S. Hamilton ** and C. Richards ***

Key words: Electrical imaging, Earth resistance, Ground penetrating radar, Landscapes of construction, Easter Island.

Rapa Nui or Easter Island is home to some of the most recognisable archaeological monuments in the world, the iconic monolithic *moai* statues. The island is situated in the Eastern Pacific, approximately 3 000 km west of the coast of Chile and 2 500 km from Tahiti. The isolated location of the island is due in part to its formation by a series of volcanic eruptions. The differing stone types formed as a result of this volcanic activity are a key element in the monumental structures such as the *moai* (statues) and *ahus* (ceremonial platforms). The *moai* are generally carved from tuff, while the *pukao* (statue topknots) are sculptured from red scoria. These stones are very different in appearance and add to the monumentality of the statues of which they are part.

Because the *moai* and their associated *ahus* are so monumental, research on Rapa Nui has often concentrated on these structures, rather than considering the wider landscape context of the sites. The Rapa Nui Landscapes of Construction project (Hamilton *et al.* 2007; Hamilton, 2008; Hamilton *et al.*, 2008), a collaboration between individuals from University College London, University of Manchester, CONAF and the Museo Antropologico P. Sebastian Englert, Rapa Nui, aims to redress this imbalance and builds upon previous work by individuals such as Charles Love and Terry Hunt (Love, 2001; Lipo and Hunt, 2005).

The 2009 season of geophysical survey was intended as a pilot study to explore how best geophysics could be employed by the project, specifically looking at the sorts of archaeological question it could usefully be used to address. Although the project as a whole was landscape based, the geophysical survey employed was small scale and very specifically targeted to answer these questions.

It was also hoped that by identifying the techniques which worked best on the island, these techniques could be used in the future both to answer archaeological questions but also to aid the conservation and heritage management of the monuments. The sites of Rapa Nui are under increasing threat as visitor numbers increase and the benefits of using geophysical survey have already been demonstrated on several World Heritage Sites, not least the Heart of Neolithic Orkney World Heritage Area, on which several of the authors have worked extensively. In this case, large scale survey has been used to obtain contextual information relating to the well known extant monuments of the area. In future, perhaps a similar approach could be employed around several of the iconic sites of Rapa Nui, to aid their interpretation and to ensure that they are managed correctly.

During the course of the work, earth resistance, ground penetrating radar and electrical resistivity tomography survey

* *Orkney College Geophysics Unit, Orkney College, East Road, Kirkwall, KW15 1LX, UK. (Mary.saunders@orkney.uhi.ac.uk)*
** *Institute of Archaeology, University College London, 31 – 34 Gordon Square, London, WC1H 0PY, UK.*
*** *Department of Archaeology, University of Manchester, Oxford Road, Manchester, M13 9PL*

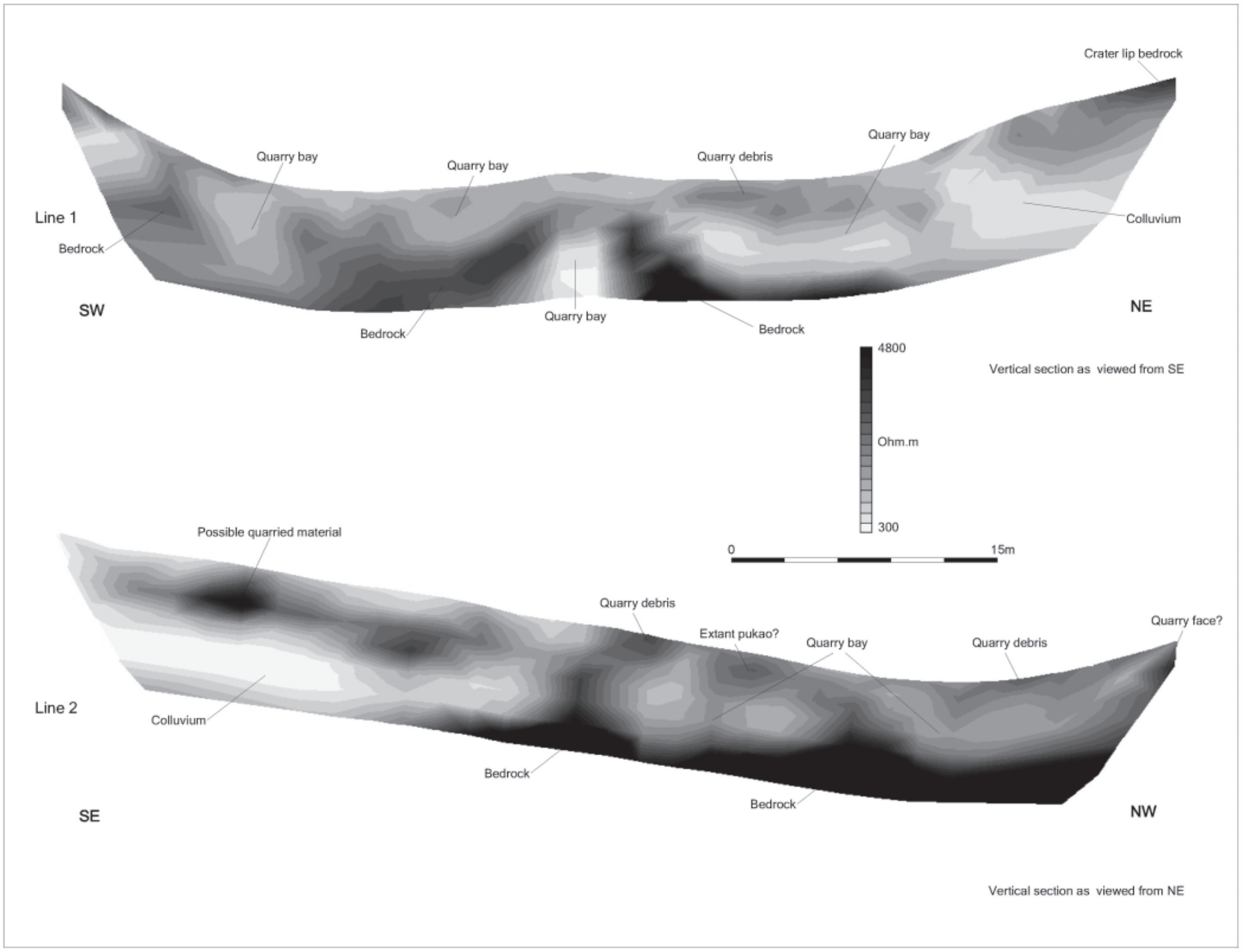

Figure 1: Electrical Puna Crater ERT data.

were all employed on various sites around the island. A TR Systems resistance meter, a GSSI Sir-3000 with 270 MHz antenna and Iris Instruments Syscal Pro ERT system were all deployed.

Much of the geophysics survey concentrated around the site of Puna Pau, the quarry from which the statue topknots were obtained and where a small excavation was also undertaken. The modern positions of the *pukao* suggest that the modern ground surface may differ greatly from the original paleosurface. A gridded ground penetrating radar survey, followed by several lines of electrical imaging, was undertaken on the northern slopes of the hill in an attempt to better characterise this paleosurface, identify potential quarry bays and to attempt to locate the route of a roadway running out from the quarry. Both data sets suggested an irregular subsurface, pointing towards the presence of colluvium filled quarry bays. Further *pukao* are evident within the Puna Pau crater and ERT survey was employed here. The data, when taken in conjunction with modern topography, suggest both the presence of quarry bays and the deposition of a large amount of colluvium into the base of the crater.

Perhaps surprisingly, given the extremely dry ground conditions, earth resistance survey also proved successful (Fig. 2). Very small areas were investigated around the bases of two fallen *moai* in an effort to identify platforms on which these statues once stood. It has been long suggested that these *moai* were abandoned while on route to somewhere else. During excavation in 1985 (Hyerdahl *et al.*, 1989), Hyerdahl identified a small platform at the base of one of these abandoned *moai* and earth resistance was used to attempt to identify similar features near the fallen *moai*, supporting the idea that these particular statues had been quite deliberately erected by the side of the road.

At perhaps the more iconic Rapa Nui site, the *moai* quarry of Rano Raraku, a small trial area of ground penetrating radar and ERT was undertaken over the known location of a buried *moai* in order to obtain an idea of the responses which could be expected over this type of feature, with a

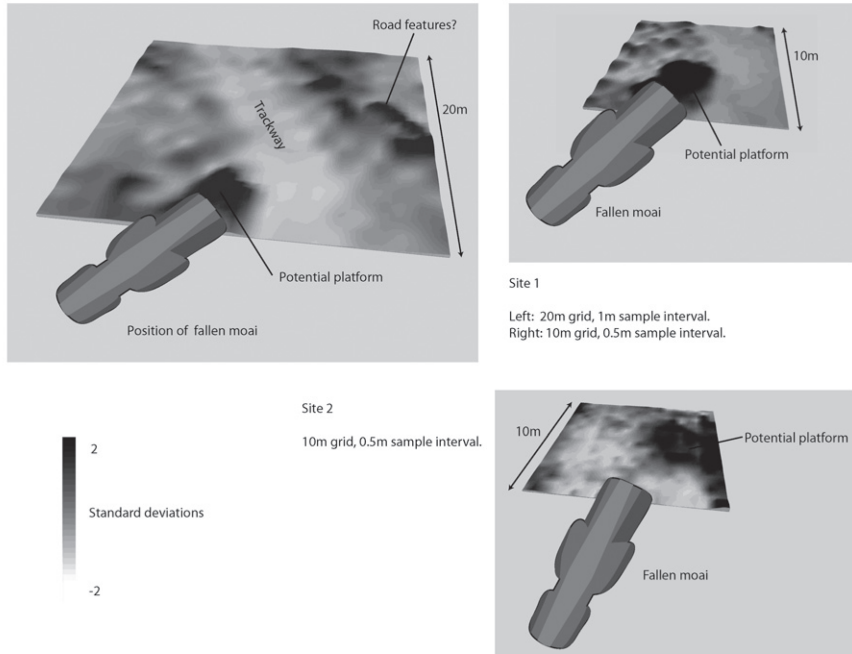

Figure 2: Earth resistance survey results.

view to greatly expanding the survey in future years. It is likely that there are many unidentified buried *moai* across the site and geophysical survey may offer a means by which these can be located without the need for excavation. Such work should allow a better understanding of the site which in turn will influence decisions regarding its management and conservation.

As can be seen in Figure 3, the four lines of ERT appear to have been very successful. Several discrete high resistivity anomalies, almost certainly relating to the known buried *moai*, and others perhaps indicating the existence of nearby unknown statues, have clearly been identified within a matrix of very low resistivity colluvial material. Radar survey over the same area yielded very subtle results. Given the position of this site on the side of a steep hill, the static nature of ERT survey makes it a very appropriate technique.

Of the techniques used, it was perhaps the electrical imaging that was most successful, despite the very dry conditions. Spacings of 0.5 m, 1 m and 2 m were employed in various situations and all appeared successful. The results over the buried *moai* at Rano Raraku were particularly interesting. Earth resistance also appeared more successful that might have been expected, particularly after a period of rain. Although there were some problems with contact resistance, the results were still very useful. Ground penetrating radar appeared to be the least successful of all the techniques employed. A 270 MHz antenna was chosen because of the likely depth of deposits on the quarry sites; however, it soon became apparent that because of the extremely dry soil, a 400 MHz antenna may well have been more appropriate.

Despite the problems with the import (and export) of equipment, the work carried out by OCGU was an enjoyable and useful experience. In the highly sensitive environment of Rapa Nui, increasingly under threat from visitors, it is clear that geophysical survey can go some way towards answering a number of archaeological questions without the need for excavation. As has been demonstrated in other parts of the world, not least on Orkney itself, geophysical survey is a powerful tool for conservation and heritage management and may prove to be very useful on Rapa Nui as these issues become increasingly important.

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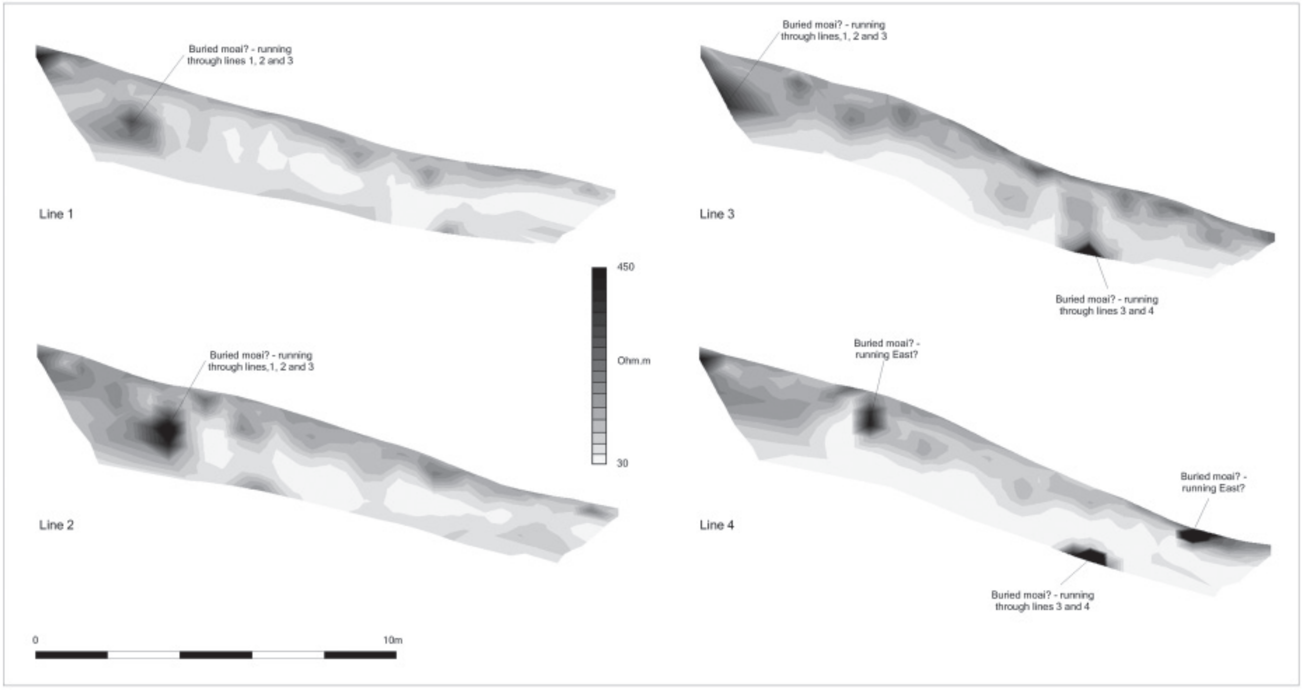

Figure 3: Rano ERT data.

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